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Notice of Allowability	Application No.	Applicant(s)	
	10/628,556	ELEFTHERIOU ET AL.	
	Examiner	Art Unit	
	Ted Kim	3746	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address--

All claims being allowable, PROSECUTION ON THE MERITS IS (OR REMAINS) CLOSED in this application. If not included herewith (or previously mailed), a Notice of Allowance (PTOL-85) or other appropriate communication will be mailed in due course. **THIS NOTICE OF ALLOWABILITY IS NOT A GRANT OF PATENT RIGHTS.** This application is subject to withdrawal from issue at the initiative of the Office or upon petition by the applicant. See 37 CFR 1.313 and MPEP 1308.

1. ☒ This communication is responsive to *10/01/2007*.

2. ☒ The allowed claim(s) is/are *1-3,5,6 and 17-19*.

3. ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
   a) ☐ All b) ☐ Some* c) ☐ None of the:
      1. ☐ Certified copies of the priority documents have been received.
      2. ☐ Certified copies of the priority documents have been received in Application No. _____ .
      3. ☐ Copies of the certified copies of the priority documents have been received in this national stage application from the International Bureau (PCT Rule 17.2(a)).

   * Certified copies not received: _____.

Applicant has THREE MONTHS FROM THE "MAILING DATE" of this communication to file a reply complying with the requirements noted below. Failure to timely comply will result in ABANDONMENT of this application.
THIS THREE-MONTH PERIOD IS NOT EXTENDABLE.

4. ☐ A SUBSTITUTE OATH OR DECLARATION must be submitted. Note the attached EXAMINER'S AMENDMENT or NOTICE OF INFORMAL PATENT APPLICATION (PTO-152) which gives reason(s) why the oath or declaration is deficient.

5. ☐ CORRECTED DRAWINGS (as "replacement sheets") must be submitted.
   (a) ☐ including changes required by the Notice of Draftsperson's Patent Drawing Review (PTO-948) attached
      1) ☐ hereto or 2) ☐ to Paper No./Mail Date _____.
   (b) ☐ including changes required by the attached Examiner's Amendment / Comment or in the Office action of Paper No./Mail Date _____.

   Identifying indicia such as the application number (see 37 CFR 1.84(c)) should be written on the drawings in the front (not the back) of each sheet. Replacement sheet(s) should be labeled as such in the header according to 37 CFR 1.121(d).

6. ☐ DEPOSIT OF and/or INFORMATION about the deposit of BIOLOGICAL MATERIAL must be submitted. Note the attached Examiner's comment regarding REQUIREMENT FOR THE DEPOSIT OF BIOLOGICAL MATERIAL.

Attachment(s)

1. ☒ Notice of References Cited (PTO-892)
2. ☐ Notice of Draftperson's Patent Drawing Review (PTO-948)
3. ☐ Information Disclosure Statements (PTO/SB/08), Paper No./Mail Date _____
4. ☐ Examiner's Comment Regarding Requirement for Deposit of Biological Material
5. ☐ Notice of Informal Patent Application
6. ☐ Interview Summary (PTO-413), Paper No./Mail Date _____ .
7. ☒ Examiner's Amendment/Comment
8. ☒ Examiner's Statement of Reasons for Allowance
9. ☐ Other _____.

EXAMINER'S AMENDMENT

1. An examiner's amendment to the record appears below. Should the changes and/or additions be unacceptable to applicant, an amendment may be filed as provided by 37 CFR 1.312. To ensure consideration of such an amendment, it MUST be submitted no later than the payment of the issue fee.

Authorization for this examiner's amendment was given in a telephone interview with Sebastien Clark on 1/7/2008.

The application has been amended as follows:

Specification

The following paragraphs of the specification have been replaced as follows:

[0002] Affordable, "personal" jet aircraft are fast becoming a reality in the general aviation market, very small turbofan engines are required for power. Such aircraft require "very small" turbofan engines (i.e. 2000 pounds thrust and under) which can be economically operated by the general aviation pilot. Small scale turbofan gas turbine engines are known for use in expendable missiles in the delivery of military ordinance, however considerations such as cost-effective, affordable and efficient operation, and durability measured in thousands of hours (not minutes), have been irrelevant to their designers. Such prior art missile engine designs, therefore, provide none of the key deliverables required for such a market to be realized. Likewise, industrial microturbines are available, but their designs are ill-suited for use as an aircraft prime mover, for obvious considerations such as weight and size.

[0003] Scaling down of conventional civilian non-expendable turbofan engines, however, also presents difficulties due mainly to the disproportionate scaling of certain factors, such as strength to weight and tolerances. For example, non-expendable turbofan engines typically have a segmented case assembly, mainly for weight reduction reasons, but also to facilitate fabrication and assembly. A conventional case assembly 200 is illustrated in FIG. 1, and includes a fan case 202, an intermediate case 204, a compressor case 206, a gas generator case 208, a turbine case 210 and a turbine exhaust case 211 about centreline 212. The gas generator case 208, turbine case 210 and turbine exhaust

case 211 surround the hot section of the engine and are typically made of steel or nickel alloys, which have good thermal resistance properties. However steel is relatively heavy, and therefore cooler portions such as the intermediate case 204 and the compressor case 206 typically employ lighter materials such as magnesium and/or aluminium. Steel is conventionally used for the fan case 202 because its strength is desirable for containing blade-off events.

[0007] Therefore, as the affordable general aviation turbofan engine market develops, significant design problems are presented to the designer. Scaled-down turbofans are simply inefficient and heavy, and thus too expensive to operate in the general aviation market. Civilian version of expendable missile engines and airborne version of microturbines are also ineffectual solutions to the design problems presented. Thus, it is important to address the design problems of the very small turbofan engine.

[0029] FIG. 12 is a somewhat schematic cross-sectional view showing assembly steps according to the present invention.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0029] Referring to the drawings, beginning with FIG. 3, an non-expendable exemplary turbofan gas turbine engine 10 according to the present invention includes in serial flow communication about a longitudinal central axis 12, a fan assembly 13 having a plurality of circumferentially spaced fan blades 14, a compressor section 16 having a plurality of circumferentially spaced low pressure compressor (LPC) blades 50 and high pressure compressor (HPC) blades 51, a diffuser 18, a combustor 20, a high pressure turbine (HPT) 22, and a low pressure turbine (LPT) 24. LPT 24 is connected to the fan assembly 13 by a first or low pressure (LP) shaft 26, and HPT 22 is connected to compressor assembly 16 by a second or high pressure (HP) shaft 28. Fuel injecting means 30 are provided for injecting fuel into the combustor 20 assembly 16 by a second or high pressure (HP) shaft 28. Fuel injecting means 30 are provided for injecting fuel into the combustor 20.

[0040] In a second aspect of the present invention, a configuration for casing 32 is disclosed which provides further benefits to the very small turbofan. Referring to FIGS. 4 and 5, the structure of the intermediate portion 46 of casing 32 will now be described in more detail. The intermediate portion 46 includes an annular outer portion or outer ring 68 having a forward end 70 and a rearward end 71 integrated with the radially outwardly extending bypass duct flange 60. On the external surface of the outer ring 68 are provided

stabilizing ribs 72, which reinforce the rigidity of the outer ring 68, and engine mounts 74 which also assist in this regard. A mounting support 82 on the outer ring 68 is provided for operatively supporting the AGB tower shaft (not shown), and to provide further stiffness to ring 68. Also provided on the outer ring 68 are attachment brackets 84 for attaching the AGB. Other services, such as oil tube inlet 83 and N1 probe boss 85A, are also provided.

[0041] The intermediate portion 46 of casing 32 also includes an annular inner portion including an inner hub 76 which has a forward end 78 and a rearward end 80. The inner hub 76 is positioned coaxially with the outer ring 68 and is supported within the outer ring 68 by a plurality of casing struts 40 which are circumferentially spaced apart and extend radially outwardly and generally rearwardly from the inner hub 76 to the outer ring 68, as will be described further below. The annular bearing seat 58 which receives and supports preferably the HPC bearing 59 (see FIG. 3) is integrally attached (for example, by welding, as described below) to the rearward end 80 of the inner hub 76. A mounting flange 77 is also provided on the forward end 78 of the inner hub 76 (see FIGS. 4 and 5) for attaching a forward bearing housing (not shown) for the LP shaft bearings.

[0042] The annular inner portion of the intermediate portion 46 of casing 32 also includes a splitter 42, which includes an annular inner wall 85 and an annular outer wall 86 extending axially and downstream relative to the air flow through engine 10, divergent from an annular leading edge tip 88. A section of the annular bypass path 37 is thereby defined between the outer ring 68 and the annular outer wall 86 of the splitter 42, while core flow path 36 is defined between the annular inner wall 85 of the splitter 42 and the inner hub 76. A stiffener 94 is provided within splitter 42, between the inner and outer walls 85, 86, and affixed thereto, and preferably also affixed to struts 40, as will be described further below. As described previously, the compressor shroud 48, which is preferably thicker than the inner wall 85 of the splitter 42 to withstand the demands of the compressed air flow, is integrated (for example by welding, as described further below) to the inner wall 85.

Claims

1. (Currently Amended) A casing for a non-expendable turbofan engine, substantially encasing at least a fan assembly, a compressor assembly, a combustor assembly and a turbine assembly, the casing comprising:

a fan case portion surrounding the fan assembly;

an annular intermediate case portion having an annular outer portion aligned with projecting axially rearwardly from the fan case portion and an annular inner portion ; and

a gas generator case portion aligned with and extending axially rearwardly from the intermediate case annular inner portion and housing the combustor assembly,

wherein the fan case portion, the intermediate case annular outer and inner portions and the gas generator case portion are integrally joined together, thereby forming an integral casing.

Cancel claims 7-16

19. (new) A non-expendable turbofan engine comprising a casing as defined in claim 1.

REASONS FOR ALLOWANCE

2. The following is an examiner's statement of reasons for allowance: the prior art of record do not fairly teach in permissible combination the claimed invention. In particular, the claims are now directed to the class of gas turbine engines that are non-expendable. Expendable engines include missiles and other weapons and is a term commonly used in the art, see e.g. the patent to Harris (6,931,862). Furthermore, in the view of the examiner, conventional engines used as a weapon, such as aircraft flown by kamikaze pilots or the aircraft used in the terrorist attack on New York on 9/11/2001, also should be categorized as expendable engines. Thus before the amendment to the claims above, even making a conventional engine casing integral as could be down when the engine is itself to be used in a weapon would be easily contemplated to those in the art as the maintenance and longevity of the engine are unimportant or as the other previously applied reference(s) taught using making integral by welding in place of bolting for the fan case. However, making the specific type of casing claimed above integral for non-expendable engines is deemed to be unobvious to one of ordinary skill in the art. For non-expendable gas turbine engines, these are built to be repaired and maintained. There are many conditions which occur which require maintenance and repair, and it is generally preferred that the maintenance be done while the engine is on the wing to reduce costs and complexity to the repair process. An integral casing would constitute a severe hindrance to the maintenance of the conventional engine and would greatly increase the cost and complexity of the maintenance process when an engine does need

repair as in many cases it may require removal of the engine from within the casing to repair/maintain the engine.

3. Any comments considered necessary by applicant must be submitted no later than the payment of the issue fee and, to avoid processing delays, should preferably accompany the issue fee. Such submissions should be clearly labeled "Comments on Statement of Reasons for Allowance."

Contact Information

Any inquiry concerning this communication or earlier communications from the Examiner should be directed to Ted Kim whose telephone number is 571-272-4829. The Examiner can be reached on regular business hours before 5:00 pm, Monday to Thursday and every other Friday.

The fax number for the organization where this application is assigned is 571-273-8300.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Devon Kramer, can be reached at 571-272-7118. Alternate inquiries to Technology Center 3700 can be made via 571-272-3700.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). General inquiries can also be directed to the Patents Assistance Center whose telephone number is 800-786-9199. Furthermore, a variety of online resources are available at http://www.uspto.gov/main/patents.htm

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